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ON THE ANALYSIS OF THE DEPOSIT FROM A CHALYBEATE WATER.

By E. C. CASE.

During the past year there have been carried on in the chemical laboratory of the State University a series of very careful analyses of the river water which furnishes the commercial supply for the city of Lawrence. A portion of the water supplied was taken from a well situated a few hundred feet from the bank of the river, and this water presents marked differences from the river supply, and is in many respects different from that of the surrounding wells. In cleaning the well, during the above-mentioned investigations, a deposit was found in the bottom, consisting mainly of oxide of iron. This deposit was some two feet thick and of a homogenous character. It was thought that an examination of this sediment might be useful as giving some clue to the dissolved matters of the underground waters of this region, and as to the part that would be deposited when the water stood where there would be little opportunity for aeration.

The well stands near the bank of the river and is sunk in a bed of gravel, part of the moraines of the earlier glacial epoch. These drift pits are full of limonite in nodules and scattered masses, so that any water filtering through them would easily take up iron, especially with the aid of any carbonic acid gas that might be in solution in the water. An analysis of the water gave the following composition, in parts per 100,000:

Silica and insoluble matter.....	4.50
Oxides of iron and alumina.....	3.45
Calcium oxide	12.25
Magnesium oxide	3.20
Sulfuric anhydride	5.48
Chlorin	8.64

The above constituents are probably combined in the following order:

Silica and insoluble matter.....	4.50
Peroxide of iron and alumina.....	3.45
Calcium sulfate	9.31
Calcium carbonate	15.03
Magnesium carbonate	6.72
Sodium chlorid.....	14.43
Total	53.44

This water contained 35.15 parts of carbonic anhydride per 100,000 parts of water. Of this amount 10.14 parts would be required to combine with the lime and magnesia, as above computed, leaving 25.01 parts of carbonic anhydride free, or to keep the bicarbonates in solution.

On standing in the air the water, which is as clear as distilled water when first drawn, becomes first milky then turbid within an hour, but does not deposit all the iron under 36 hours. Then the water again becomes clear by settling. Below is the analysis of an air-dried sample of the sediment found in the well, this being the deposit from the water when it has not a full opportunity for aeration:

Silica and insoluble matter.....	19.30
Peroxide of iron and alumina.....	46.95
Calcium oxide	4.20
Magnesium oxide34
Sulfuric anhydride15
Water, driven off below 100 degrees C.....	9.15
Water, driven off above 100 degrees C.....	14.40
Chlorin31
Carbonic anhydride	3.12
Sodium oxide (calculated)39

The most probable combination is the following:

Silica and insoluble matter.....	19.30
Iron and alumina oxides	*46.95
Calcium sulfate25
Calcium carbonate	7.32
Magnesium carbonate75
Sodium chlorid60
Water, driven off at 100 degrees C.....	9.15
Water, driven off at 230 degrees C.....	14.40
Organic matter (undetermined)	1.28
Total	100.00

From an examination of these analyses it can be seen that the silica is retained in solution to a much larger extent than the iron; the part of the silica retained, however, being only a portion of that dissolved in the original water, as is shown by the character of the deposit.

The copious deposit of iron is a very instructive illustration of how much of this substance the underground water, saturated with carbon dioxide, can hold in solution, and the ease with which it is deposited on the slightest contact with air. The sulfates and the sodium chlorid are deposited only to a limited extent, while carbonates of calcium and magnesium are deposited freely. This latter deposition would be expected, since the excess of carbon dioxide has had an opportunity to escape, thus precipitating the carbonates. This is then a process of softening, as far as those substances that make up what is known as the temporary hardness of the waters is concerned.

The presence of a large quantity of water, and especially the characteristic amount given off at 230 degrees C., shows that the deposit is practically an ore of iron, in fact, limonite. This might be considered as transported from the surrounding gravel as such, were it not that the water is so clear when it first runs into the well, so it is more rational to believe that the iron is first dissolved in the highly carbonated water, for in the freshly drawn water it is always present in the ferrous state, and is later oxidized to ferric iron and at the same time deposited. Upon heating the deposit a dark reddish paint is obtained. It might be supposed that there would be a large amount of organic matter in this deposit, since there is no doubt that the organic substances in the soil have played a very important part in the changes that the water has undergone, but on examination with the microscope no organized organic remains can be discovered.

*Nearly all oxide of iron.